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Application of a top-down modelling strategy to a large sample of catchments

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The large and constantly increasing number of available hydrological models and computing power calls for improved model evaluation procedures that help model users to distinguish between different models and support them in the selection of an adequate model for a given task. While currently the decision of which model to use is made individually for each situation, we ideally would like to be able to decide, based solely on the catchment and climate properties, which model structure(s) to use. Our work is a contribution in that direction.

For being able to identify relationships between model performance and catchment properties, we do need a large number of catchments that cover the encountered variability of climate and catchment properties. This is why our study uses the results of over 500 catchments in the US that are modelled with eight models of increasing complexity. We further use four different signatures that describe the hydrological water balance at different time scales. Our models are evaluated based on the three error sources into which the mean squarer error can be decomposed. These error sources are the bias, standard deviation and correlation errors which describe the ability of the model to replicate the mean discharge, its variance and also the shape and timing of the hydrograph.

Our results show that performance between models varies with climate and terrain properties and highlights how this information can be used for developing different approaches that exploit this link for aiding in model selection.